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HISTORICAL USE OF BAMBOO/CANE AS BLACKBIRD AND STARLING ROOSTING HABITAT: IMPLICATIONS FOR ROOST MANAGEMENT

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Abstract.—The historical use of bamboo/cane as blackbird and starling roosting habitat was analyzed from U.S. Fish and Wildlife Service roost survey reports to assess the potential for shifting roosting populations away from objectionable urban sites where there may be nuisance or human health concerns. The following criteria were used to assess this potential: (1) frequent historical use by blackbirds and starlings compared with other habitat; (2) history of accommodating high bird densities on a limited area compared with other habitat; (3) history of repeated localized utilization by roosting blackbirds and starlings; (4) history of utilization over a wide geographic range; and (5) history of occupation by starlings and all major blackbird species. Of the diverse habitat historically reported to be used by wintering blackbirds and starlings for roosting, bamboo/cane uniquely appeared to meet all criteria as a widely used habitat that supports maximum densities of all primary roosting species. The possible ecological attractiveness of bamboo/cane as roosting habitat is discussed. Although the data are lacking to suggest that cane is sufficiently attractive to shift roosting behavior of blackbirds and starlings from objectionable sites, bamboo/cane is clearly a candidate for further research into this concept.

USO HISTÓRICO DE LOS BAMBÚES COMO HABITAT DORMIDERO DE AVES ICTÉRINAS: IMPLICACIONES PARA EL MANEJO DE DORMIDEROS

Sinopsis.—El historial de los bambusales/cañaverales como habitat de icterinos para pernoctar se analizó usando información del Servicio de Pesca y Vida Silvestre de los E.E.U.U. con miras a evaluar el potencial para trasladar dormideros lejos de áreas urbanas objetables donde pueden causar malestar o levantar riesgos a la salud. Se siguieron los siguientes criterios para examinar este potencial: (1) el historial de uso frecuente por ictérinos en comparación con otros habitats; (2) el historial de acomodar altas densidades de aves en un área pequeña en comparación con otras; (3) el historial de uso consistente del lugar por ictérinos para pernoctar; (4) el historial de uso a través de una gran área geográfica; y (5) el historial de uso por las principales especies ictérinas. De los diversos habitats históricamente reportados como usados para pernoctar por ictérinos invernales, sólo los bambusales/cañaverales parecen cumplir todos los criterios, siendo éste un habitat comúnmente usado que sostiene altas densidades de especies que forman principalmente dormideros. Se discute el

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atractivo potencial ecológico de los bambusales/cañaverales como habitat de dormitar. Aunque falta información para sugerir que la caña es suficientemente atractiva para alterar el comportamiento de pernoctar en lugares objetables de algunos ictérinos, la mezcla de bambú y caña es un candidato claro para mayor estudio dentro de este concepto.

Residents of the southeastern United States have long been concerned about the wintering populations of blackbirds (Common Grackles [*Quiscalus quiscula*], Red-winged Blackbirds [*Agelaius phoeniceus*], Brown-headed Cowbirds [*Molothrus ater*]) and European Starlings (*Sturnus vulgaris*) that annually occur in large roosts (Graham 1976). Most of these concerns occur where roosting assemblages exist near human habitation. These urban/surburban situations cause substantial nuisance problems (Bliese 1959, Garner 1978, Meanley 1975), and, when recurring in specific sites over several years, are histoplasmosis threats (Chick et al. 1980, Latham et al. 1980). Past approaches to alleviating blackbird/human conflicts in these situations have been forced relocation and lethal control. Forced relocation of the roosting population using either fright producing devices (Mott 1980) or habitat alternation (Garner 1978), is often successful in reducing problems, but presents the risk of moving birds to an equally undesirable location (Mott 1984). In some situations, lethal control of the local population at the roost site has occasionally been used (Garner 1978). Although also sometimes effective, it presents additional problems associated with carcass removal that may exacerbate the histoplasmosis threat (Glahn et al. 1991).

One possible means of alleviating urban/surburban roost problems is to establish selected roosting habitat away from human habitation that would be sufficiently attractive to shift roosting behavior away from objectionable sites. Little is known about the type of habitat that might serve this purpose, however. Meanley (1965) indicated that habitat with dense cover was important and described regionally specific vegetative communities typically used by Red-winged Blackbirds in the South. Although redwings often roost in rice fields and marsh vegetation over water, they achieve the highest roosting density in deciduous trees and other tall vegetation where vertical stratification is possible (Meanley 1965).

More recent quantitative studies have suggested that roost sites are typified by high tree density and low mean basal stem areas associated with early stages of succession (Lyon and Caccamise 1981, Micacchion and Townsend 1983). Also important were factors that defined a dense canopy providing abundant suitable perching positions (Micacchion and Townsend 1983). These roost structure factors improve thermoregulation and predator protection that are often cited as benefits of communal roosting (Eiserer 1984). These studies also suggest that earlier and later stages of succession of such sites are probably unsuitable for winter roosting birds. The length of time that habitat might be attractive for roosting birds is an important consideration. This period of occupation by roosting birds can be further abbreviated by the birds themselves causing habitat destruction from one or more years of occupation (Marples 1934). Clearly, to achieve the objective of consistently attracting blackbirds and starlings

away from objectionable sites, a candidate habitat would have to become attractive to roosting birds in a relatively short period, and remain attractive for an extended period, to justify the costs of establishing them. Such a habitat should also have optimal roost site characteristics to be ecologically attractive and to maintain high bird densities on a minimum amount of land area.

From the single-species cover types of blackbird roosting habitat described by Meanley (1965), only native bamboo or cane referred to as canebrakes (*Arundinaria* sp.) and introduced species of bamboo (*Phyllostachys* sp.) appeared to meet the initial criteria of extremely high stem density, minimum basal area, dense evergreen canopy and heights similar to trees to achieve high densities through vertical stratification. In contrast to trees, however, cane may not be susceptible to successional changes that would reduce its attractiveness as roosting habitat. We examined the historical use of bamboo/cane as blackbird and starling roosting habitat from roost survey reports to help define its suitability as optimal roosting habitat.

METHODS

We used the following criteria to evaluate bamboo/cane quantitatively and qualitatively: (1) frequent historical use by blackbirds and starlings compared with other habitat; (2) history of accommodating high bird densities on a limited area compared with other habitat; (3) history of repeated localized utilization by roosting blackbirds and starlings; (4) history of utilization over a wide geographic range; and (5) history of occupation by starlings and all major blackbird species. To assess criteria 1 and 2, we examined data on blackbird and starling roosts $\geq$100,000 birds from winter blackbird/starling roost surveys conducted by the U.S. Fish and Wildlife Service for the years 1974–1975 (Meanley and Royall 1976) and 1976–1977 (W. C. Royall, Denver Wildlife Research Center, unpub. data). These surveys were used for analysis because they were the most recent, complete, nationwide surveys where roosting habitat had been adequately described. Briefly, these surveys were conducted by Fish and Wildlife Service personnel and cooperators during the winter months (December–February) in 16–31 eastern states and 12–17 western states. To assess criteria 3–5, however, we examined data from all roosts included in unpublished reports from surveys conducted from 1962–1963 through 1971–1972 (B. Meanley and J. S. Webb, Patuxent Wildlife Research Center, unpub. data) and 1979–1980 (A. R. Stickley Jr., Denver Wildlife Research Center, unpub. data); as well as 1974–1975 and 1976–1977. These latter surveys, with the exception of 1980, were limited primarily to a varying number of southeastern States, and in 1980 to more grossly grouped habitat types. Data reported consistently from these surveys and considered in the analysis were: year of survey, county and state of roost, roost size and species composition, type of habitat, and acreage of habitat occupied. We grouped the habitats reported in these surveys into 18 categories (Table 1). As a result of their similar vegetative characteristics,

TABLE 1. Percent occurrence of all large (≥100,000 birds) and major (≥1 million birds) blackbird/starling roosts by habitat category identified during U.S. Fish and Wildlife Service winter roost surveys in 1974–1975 and 1976–1977.

Habitat type	Roosting population size of blackbirds			
	≥100,000		≥1 million	
	n	%	*n*	%
All cane	64	12.1	33	11.5
Bamboo/cane	27	5.1	12	4.2
Sugar cane	10	1.9	6	2.1
Cane-other	27	5.1	15	5.2
All marsh	83	15.6	34	11.8
Cattail (*Typha* sp.)	33	6.2	10	3.5
Cattail-other	22	4.1	13	4.5
Other marsh	28	5.3	11	3.8
All conifers	160	30.0	95	33.0
Cedar (*Juniperus* sp.)	14	2.6	5	1.7
Cedar-brush	20	3.8	12	4.2
Pine (*Pinus* sp.)	30	5.6	22	7.6
Pine-brush	13	2.4	10	3.5
Mixed/unknown conifers	83	15.6	46	16.0
All hardwoods	116	21.8	66	22.9
Hardwood trees	33	6.2	11	3.8
Hardwood-brush	83	15.6	55	19.1
Miscellaneous	109	20.5	60	20.8
Mixed unknown trees	50	9.4	35	12.2
Mixed/unknown shrubs	11	2.1	6	2.1
Miscellaneous swamp	30	5.6	18	6.2
Other vegetation	1	0.2	0	0
Human-made structures	17	3.2	1	0.3

bamboo and native canebrakes were grouped as cane. Multi-species roosts were categorized by the most abundant species and the term "mix" (i.e., redwing-mix). An estimate of roosting density was calculated for each roost reported by dividing roosting population size by the estimated area of roosting habitat. The error of this estimate is unknown, but was assumed to be the same among habitats. A Kruskal-Wallis analysis of variance of ranked data (Hollander and Wolfe 1973) was used to test for differences in roosting densities and habitat occupied among habitat types.

RESULTS

From analysis of the 1974–1975 and 1976–1977 surveys, most (61.2%) roosting habitat was comprised of various types of trees often mixed with brush (Table 1). Marsh and swamp habitat made up most (21.2%) of the rest (Table 1). Pure stands of bamboo/cane were reported as roosting habitat in 27 (5.1%) of the 532 roosts with ≥100,000 birds (Table 1). Another 27 sites (5.1%) had cane mixed with other vegetation. Cane had

TABLE 2. Mean roosting densities (birds × 1000/ha) and median area of roosting habitat occupied (ha) by ≥100,000 blackbirds and starlings among categories of roosting habitat identified during U.S. Fish and Wildlife Service winter roost surveys in 1974–1975 and 1976–1977.

Habitat type	Habitat occupied		Roosting density	
	Median[1]	Minimum	Maximum	$\bar{x}$[1]
Bamboo-cane	0.81^{A}	0.30	2471.0	821.2^{AB}
Sugar cane	15.18^{BCDE}	1.21	864.8	265.7^{ABCDE}
Cane-other	2.22^{ABC}	0.20	1235.5	462.4^{ABC}
Cattail	24.28^{E}	2.02	126.0	27.9^{E}
Cattail-other	9.10^{DE}	0.81	1606.1	275.6^{CDE}
Other marsh	6.07^{BCDE}	0.20	889.5	199.9^{DE}
Cedar	3.43^{ABCD}	0.81	1853.2	278.3^{BCDE}
Cedar-brush	4.05^{ABCD}	1.62	1482.6	421.5^{ABCD}
Pine	4.05^{ABC}	0.40	1667.9	616.6^{A}
Pine-brush	1.62^{ABCD}	0.81	1482.6	557.5^{AB}
Unknown conifers	2.43^{ABC}	0.40	4118.3	692.3^{AB}
Hardwood trees	7.69^{DE}	0.41	1235.5	207.1^{CDE}
Hardwood-brush	2.83^{ABC}	0.20	3088.7	635.9^{A}
Unknown trees	4.05^{ABCD}	0.30	3294.7	614.3^{AB}
Unknown shrubs	4.05^{ABCDE}	0.81	1853.2	626.2^{ABCD}
Miscellaneous swamp	4.04^{BCDE}	0.81	1482.6	332.6^{ABCD}
Human-made structure	6.87^{ABCD}	0.10	6177.5	755.1^{ABCDE}

[1] Habitat parameters not sharing the same letter are different ($P < 0.05$).

a similar percentage occurrence as habitat for roosts containing ≥1 million birds (Table 1). Of single-species habitat utilized, cattails (*Typha* sp.), pine (*Pinus* sp.) and hardwood stands had only a slightly higher percentage occurrence as roosting habitat than did cane (Table 1).

Mean roosting density for cane was higher than any other habitat category. Roosting density in cane was significantly ($P < 0.05$) greater than pure stands of hardwood and all marsh vegetation, but not from other habitat categories (Table 2). The habitats most frequently used, mixed conifers and hardwood-brush, had the highest mean roosting densities after cane and human-made structures. The peak roosting density for cane in the 1974–1975 and 1976–1977 survey was approximately 2.5 million birds/ha, and was exceeded during the same years by densities of approximately 3 million, 4 million and 6 million birds/ha for mixed conifer, hardwood-brush and human-made structure roost sites, respectively. Higher roosting densities for cane, however, were reported for a roost containing 10 million birds on 2.4 ha (approximately 4 million birds/ha) and a 4-million-bird roost on 0.6 ha (6.5 million birds/ha) in 1963 and 1970, respectively. With regard to roosting area, the distribution of the means was highly skewed and so the median was used as a basis of comparison among habitats for the survey years of 1974–1975 and 1976–1977. Cane had the lowest median area needed for roosting (0.81 ha) during those years and was significantly ($P < 0.05$) different from six of 16 habitat types (Table 2).

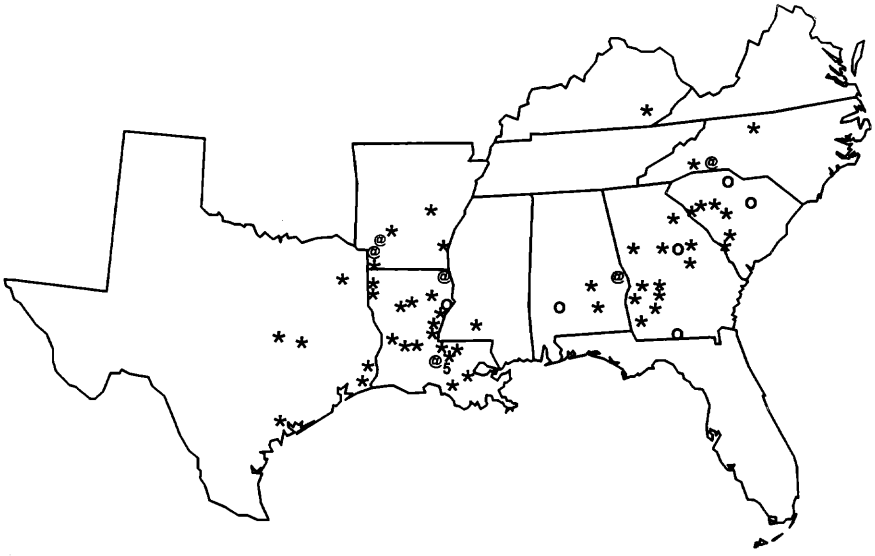

FIGURE 1. Distribution and classes of blackbird and starling occupation (* = 1 yr of reported site occupancy; @ = 2+ yr of reported site occupancy; 0 = 4+ yr of reported site occupancy; 5 = 5 separate sites of 1-yr occupancy clustered in one area) of bamboo/cane roosts identified in the southern United States during U.S. Fish and Wildlife Service winter roost surveys, 1962–1963 through 1979–1980.

Cane roosts in sizes ranging from 1000 to 10 million birds were reported 98 times during all survey years. Thirty-five of these reports were from 12 sites that were occupied by birds in more than 1 yr (Fig. 1). Six of these sites were reported to be occupied four or more times and spanned a period of 10–17 yr (Fig. 1).

Cane roosts were reported from the 10 southern states of Alabama, Arkansas, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Texas and Virginia (Fig. 1). Of these states, Louisiana had the highest frequency of cane roosts, reporting 30 (31%), of all cane roosts. In addition, cane roosts were reported from New York and New Mexico.

The frequency with which species predominated in 85 cane roosts was 44.7% for Red-winged Blackbirds, 28.2% for Common Grackles, 14.1% for European Starlings, 9.4% for Brown-headed Cowbirds and 3.5% for Brewer's Blackbirds (*Euphagus cyanocephalus*). In comparison, the mean percent species composition from the primary surveys in 1974–1975 and 1976–1977 was 37.4% for Red-winged Blackbirds, 24.3% for Common Grackles, 17.2% for European Starlings, 19% for Brown-headed Cowbirds and 2.1% for Brewer's Blackbirds.

DISCUSSION

Although having a relatively low frequency of occurrence as roosting habitat, cane was comparable in occurrence with other single-species

habitat and harbored a proportional number of major (>1 million bird) roosts. Cane was roosting habitat for starlings and all major blackbird species, approximately proportional to their relative abundance. Most notable was the Red-winged Blackbird, which is reported to prefer wetland sites, but was the most commonly occurring predominate species in these normally upland sites. Part of the reason for the representative use among species is the wide distribution of cane roosts. Whereas Red-winged Blackbirds are more numerous than grackles in the Coastal plain and especially in coastal marshes (Meanley 1965), grackles are most numerous in the southern Piedmont area (Meanley 1965), especially in Kentucky and Tennessee (Heisterberg 1979).

Although many of the roost habitat types such as cattail and phragmites (*Phragmites communis*) in coastal marshes, pine bogs on the Atlantic Coastal Plain and deciduous thickets in the Mississippi River delta appear to be important regionally (Meanley 1956), cane appears to be roosting habitat utilized throughout most of the primary wintering area of blackbirds and starlings in the southern United States as well as elsewhere. The wide distribution of cane habitat may be due to the cultivation of hardy bamboo species, primarily of the genus *Phyllostachys* for ornamental, commercial and research uses (McClure 1957). Cultivated bamboo sites, used as roosting habitat, are reported from Auburn and Montgomery, Alabama as well as Clemson, South Carolina (Meanley 1965). Unpublished reports also revealed cultivated bamboo roost sites in Camden, Alabama and Barwick, Georgia.

The repeated use of specific bamboo and canebrake roost sites over successive winters might suggest a consistent preference for this habitat over other possible available sites. Diverse habitat types have also been reported to be used year after year, however (Meanley 1965). Extremely long historical use of cane might further indicate that cane will remain desirable roosting habitat for an indefinite period. As a result of the incomplete nature of some of the roost survey years, the historical use of specific sites is difficult to assess. Clearly, reoccurrence of roosting at more than one third of the cane sites surveyed would suggest some preference for these sites in each of their geographic localities.

Of the six most traditional roosts detected in our analysis, further information was gathered on the Camden, Alabama bamboo plantation through personal communication with Agricultural Experiment Station personnel. A 10-ha plot of bamboo (*Phyllostachys* sp.) was planted in 1959. By 1963 this plot had a roost of approximately 9000 blackbirds and was reported intermittently to contain in excess of 1 million birds on roost surveys through 1980. Personnel at the station report, however, that birds have roosted there every year in varying numbers since at least 1974 to present (J. Little, pers. comm.). This nearly 30 yr of possibly uninterrupted habitat use by blackbirds rivals the traditional use of any other habitat previously reported (Eiserer 1984). The longevity of these hardy species of bamboo is not uncommon. Another plantation near Montgomery, Alabama was reported to survive over 70 yr (McClure 1957). Con-

FIGURE 2. Cultivated bamboo (*Phyllostachys* sp.) at the Auburn Agricultural Experiment Station, Camden, Alabama and typical of that used as blackbird/starling roosting habitat.

sidering the potential decrease in attractiveness of most habitat types due to succession or destruction from over fertilization with bird droppings, cane may be one of the few habitats that can sustain this extended period of bird use.

Considering the structure of bamboo stands and canebrakes (Fig. 2), which have extensive lateral branching and greater than 27,000 culms/ha (Sturkie et al. 1968), the high mean roosting density of this habitat is not surprising. In comparison, tree densities (trees/ha) of roost sites averaged 1741 and 3916 for hardwood (Lyon and Caccamise 1981) and cedar-pine habitat (J. F. Heisterberg, USDA/APHIS/Animal Damage Control, pers. comm.), respectively. Peak roosting densities, however, more clearly reflect the enormous potential roosting capacity of the this habitat which appeared to equal or exceed all other habitats. Associated with the capacity for high roosting density is the small area of bamboo/cane habitat needed to support a large roosting population. The structure of bamboo stands and canebrakes, combined with their ability to support high densities of birds, would clearly suggest optimal conditions for thermoregulation. Eiserer (1984) indicated that thermoregulatory benefits can accrue primarily by virtue of the habitat structure, but also from the clumping of conspecifics. Another possibly important benefit of communal roosting is predator protection (Eiserer 1984). The extremely high density of cane, coupled with small basal area, would seemingly preclude avian predators and provide a difficult situation for most ground predators.

Of the diverse habitats historically reported to be used by wintering blackbirds and starlings for roosting, bamboo/cane uniquely appeared to meet all our criteria as a widely used habitat that supports maximum densities of starlings and all primary blackbird species. Assuming its limited availability compared with more commonly used habitat in woodlands and marshes, the widespread and repeated use of cane habitat might suggest that cane is a preferred roosting habitat. The high roosting densities calculated for cane appear to validate its seemingly optimal physical characteristics as roosting habitat. These site characteristics would appear to be ecologically attractive, providing both thermoregulatory and predator protection benefits. Unlike woodland habitats, the attractive site characteristics of cane would not appear to be altered due to successional changes and would take a relatively short period to cultivate. Although data are lacking to suggest that cane is sufficiently attractive to shift roosting behavior of blackbirds and starlings from objectionable sites, bamboo/cane is clearly a candidate for further research into this concept. From the data reviewed, the amount of bamboo habitat needed to maintain a major roost (≥ 1 million birds) would be slightly less than 1 ha, but may be even less depending on the specific variety of bamboo cultivated. Several species of bamboo have been successfully cultivated in the southern United States (Sturkie et al. 1968), so that further research on this concept is plausible. If the concept of shifting blackbirds and starlings from objectionable sites can be demonstrated, this could be an important step toward long-term alleviation of human conflicts with blackbird/starling roosts in the southern United States.

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